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Name of the Candidate (Capital letters)	PARTH NANDANIA		
Registration No.	: 1010125018	**Major Subject** **Minor Subject**	: Agricultural Extension Education : Agricultural Economics
Current Semester	: 2nd Semester	**Degree**	: Ph. D. (Agricultural Extension Education)
Major Guide	: Dr. M. K. Bariya	**Minor Guide**	: Dr. B. Swaminathan
Title of Research Work	**: CLIMATE-SMART AGRICULTURE PRACTICES ADOPTED BY GROUNDNUT FARMERS IN SAURASHTRA REGION**		

(1) INTRODUCTION

There is nothing wrong in claiming that agriculture is the most important sector of the country and plays a significant role in fulfilling the needs of food security, employment generation, rural development and rejuvenating nature. It is also very well quoted by Dr. M. S. Swaminathan that "If agriculture goes wrong, nothing else will have a chance to go right." India is predominantly dependent on agriculture as more than two-thirds of the population reside in villages and contributes directly or indirectly to agriculture. The contribution of agriculture to a country's GDP is significant and increasing day by day in an unprecedented way. Agriculture is not only a significant contributor to GDP but also serves as the source of income, food and shelter for numerous farmers.

Increasing productivity and profitability has now become the top priority for farmers, researchers, extension workers and policymakers. So, the adoption of the improved practices will lead to long-term sustainability and profitability.

Indian agriculture is predominantly rainfed and monsoon dependent. In recent years, climate change has popped up as the emerging concern for farmers. Due to sheer dependency on monsoon, extreme weather events like high temperatures, unseasonal rainfall, drought and large dry spells can adversely affect productivity and profitability.

As we know that climate plays an integral role in the physiological functions of the crop and adverse climate conditions can pose a serious limitation on crop yield, quality, quantity and productivity.

Climate change refers to long-term shifts in temperatures and weather patterns, characterized by significant changes in the mean or variability of climate properties that persist for an extended period, typically decades or longer (United Nations). Climate change can seriously affect the crop physiological processes, soil quality, pest and disease dynamics and growth cycle of the crops. From some studies, it can be inferred that an increase in carbon dioxide levels initially boosted productivity, but the long-term increase in the carbon dioxide levels proved to be harmful for the crops, resulting in increasing the vulnerability of farmers to climatic change.

The influence of climate change and climate variability is highly noted, particularly in the rainfed regions, where the cropping is largely dependent on the monsoon and rainfall. The Saurashtra region of Gujarat state is a rainy region and covers most of its water requirements from the rainfall. But in the past two years (2023-2025), Saurashtra region has been highly affected by climate variability, leading to the incurred loss in terms of productivity and profitability. Saurashtra region mainly experiences heavy rainfall, long dry spells, high temperatures and even flooding in some parts. Climate change has increased the risk associated with farming.

Groundnut is the major crop grown in the Saurashtra region. Amongst the oilseed crops, groundnut comes at the top of the list in the Saurashtra region and serves as the key contributor to the farm income. Production and cultivation of groundnut in Saurashtra region is highly rainy and depends largely on rainfall. Production is adversely affected by extreme rainfall at the time of harvesting and high temperatures. Extreme weather phenomena can greatly deter crop quality and yields. Therefore, it becomes of the utmost importance to have resilience in groundnut-based farming systems against climate change.

According to the FAO, Climate-Smart Agriculture (CSA) is an approach that guides actions to transform and reorient agricultural systems to effectively support development and ensure food security in a changing climate. It has three main pillars:

- Increasing agricultural productivity and farmers' income
- Enhancing resilience to climate change
- Reducing greenhouse gas emissions

Climate smart agriculture (CSA) is not a single approach or practice, but CSA encompasses multiple dimensions and practices in line with the suitability of different locations. Climate-smart agriculture includes the use of improved crop varieties, integrated nutrient management, integrated pest management, integrated disease management, efficient water conservation, efficient water management, soil and moisture conservation techniques, weather-based information services and other improved practices. This approach aims to make agriculture a balanced and sustainable occupation. The CSA approach helps the farmers to make informed decisions and reduce the vulnerability to climate-related risks and uncertainties.

Despite the availability of climate-smart agriculture practices, its adoption is quite limited due to lack of sufficient knowledge, inadequate sources of information, lack of technical know-how, lack of sufficient resources, high cost of inputs, lack of collective groups, lack of training and awareness programmes and unfavourable attitude and perception towards improved practices. Farmers' knowledge, attitude, skill and perception play a crucial role in shaping their behaviour, adoption and attitude towards the modern practices. Therefore, it becomes essentially important to determine the knowledge level of farmers about CSA practices, diagnose the level of adoption and to assess the vulnerability of farmers to climate change.

In India, numerous climate-related measures have been taken. However, these efforts will go into vain if the primary beneficiaries (farmers) don't have sufficient knowledge of them. Adoption of CSA and improved practices will remain limited to some extent, if the knowledge is not conveyed to the farmers in an efficient manner. So, that is where the gap comes into the picture and to narrow this gap, it becomes very essential to know about the present status of knowledge of farmers about climate-smart agriculture practices and the extent to which CSA practices are adopted by the farmers. Add on to these, it becomes increasingly important to assess the level of vulnerability as the Saurashtra region is more vulnerable to risks and crop failure due to climate variability.

Considering the crucial role of groundnut production in the Saurashtra region and challenges associated with groundnut cultivation due to climate variability, it becomes imperative to analyze how farmers react and respond to these challenges through adoption of CSA practices. The analysis will not help to reduce the knowledge and adoption gaps but also help to build a system of sustainable agriculture by reducing vulnerability and enhancing resilience. Therefore, this study is undertaken in order to analyse the climate-smart agriculture practices adopted by the groundnut farmers in Saurashtra region.

(2) STATEMENT OF THE PROBLEM

In agricultural extension research, most studies have focused on knowledge, adoption, technological gaps and the impact of improved practices, while limited attention has been given to farmers' preparedness to cope with climatic variability through climate-resilient agricultural practices in crop-specific contexts. With increasing climate uncertainties, it becomes essential to understand how farmers respond to such challenges in terms of their knowledge and adoption behaviour.

The Gujarat, particularly the Saurashtra region, is a major groundnut-producing area where agriculture is largely rainfed and vulnerable to climatic fluctuations. Groundnut, being a key crop, is highly sensitive to erratic rainfall, drought and unseasonal rains, leading to yield instability. Although several recommended practices such as improved varieties, soil and moisture conservation, and weather-based advisories are available, their adoption is not uniform due to limited knowledge, resource constraints and inadequate extension support.

Moreover, while Climate-Smart Agriculture is increasingly emphasized, its practical application at the farmer level remains unclear, particularly in groundnut cultivation. Farmers may adopt certain climate-resilient practices without recognizing their broader significance, creating a gap between recommended practices and their actual use.

This study intends to explore the knowledge and adoption of climate-resilient agricultural practices among groundnut farmers in the Saurashtra region and to identify the factors that determine their adoption behaviour.

Keeping this in view, the research study entitled "**Climate-Smart Agriculture Practices adopted by Groundnut Farmers in the Saurashtra Region of Gujarat**" is proposed to be undertaken.

(3) OBJECTIVES OF THE RESEARCH

On the basis of the facts available and a statement of the problem, the present study entitled "**Climate-smart agriculture practices adopted by the groundnut farmers in Saurashtra region**" will be undertaken with the following objectives.

1. To study the profile of groundnut farmers in the Saurashtra region
2. To develop a climate vulnerability index for measuring the vulnerability of groundnut farmers
3. To develop a knowledge test for measuring farmers' knowledge regarding Climate-Smart Agriculture practices in groundnut cultivation

4. To determine the extent of adoption of Climate-Smart Agriculture practices by groundnut farmers
5. To explore the relationship of profile of farmers with knowledge and adoption of CSA practices
6. To identify the constraints faced by the farmers in adopting Climate-Smart Agriculture practices and seek their suggestions

(4) REVIEW OF LITERATURE

Panda and Murudaiah (2017) revealed that 38.89 per cent of the rice-pulse farmers fall under the medium category of achievement motivation, with 31.11 percent exhibiting a high level and 30 percent displaying a low level of achievement motivation, respectively.

Singh and Sinha *(*2017) noted that more than three-fourth (76.67 per cent) of the respondents opted crop and dairy farming systems. About 5 per cent had crops and poultry; 11.67 per cent had crops and beekeeping; 3.33 per cent had crops and forestry; 16.67 per cent had crops and fruits; and 8.33 per cent had crops and a floriculture farming system.

Pise *et al.* (2018) found in their research on NICRA project beneficiaries that over half (56.25 per cent) possessed medium farming experience, with low experience at 11.25 per cent and high experience at 32.50 per cent.

Pise *et al*. (2018) identified that 46.25 per cent of NICRA beneficiaries had moderate knowledge of CRA practices, with 30.00 per cent exhibiting low knowledge and 23.75 per cent showing high knowledge of CRA practices.

Krishnaji V. and Gopikrishna T. (2019) discovered that over two-fifths (45.84 per cent) of the farmers experienced a medium level of training exposure, while the others had low (32.08 per cent) and high (22.08 per cent) levels of training exposure. This could be because of the limited awareness regarding regular training sessions held by local extension workers, the timing of training programmes overlapping with their fieldwork, the absence of novelty, and the lack of programmes tailored to specific needs.

Majumdar *et al*. (2019) performed a study in West Bengal and discovered that more than half (57.50 per cent) of the growers exhibited intermediate decision-making behaviour, with high decision-making behaviour at 22.50 per cent and low decision-making behaviour at 20.00 per cent.

Prashanthi and Asokhan (2022) found that almost half (48.45 per cent) of farmers practising climate-smart agriculture (CSA) were middle-aged, with 27.33 per cent being young and 24. 22 per cent belonging to both young and old age groups, respectively.

Yuvaraj *et al.* (2022) noted that most farmers were classified as medium (59.70 per cent) in their adoption of different CSA practices, with high (30.7 per cent) and low (9.70 per cent) adopters following.

Gohil (2023) found that among male paddy growers, precisely two-fifths (40.00 per cent) displayed a medium degree of cosmopoliteness, while 28.33 per cent, 20.00 per cent, 06.67 per cent, and 05.00 per cent had high, low, very low, and very high levels of cosmopoliteness, respectively. Conversely, within the female paddy growers, precisely two-fifths (40.00 per cent) displayed a medium degree of cosmopoliteness, while 31.67 per cent, 16.66 per cent, 10.00 per cent, and 01.67 per cent had very low, low, high, and very high levels of cosmopoliteness, respectively.

Mallappa and Pathak (2023) showed that nearly two-thirds (63.33 per cent) of the farmers are small farmers, followed by marginal farmers (36.37 per cent).

Pokar (2023) presented that the majority (63.33 per cent) of beneficiaries had a medium yield index, followed by 24.17 per cent of the farmers, who had a high yield index and 12.50 per cent of them had a low yield index. When it comes to non-beneficiaries, more than three-fifths (64.17 per cent) of them had a medium yield index, followed by 19.17 per cent and 16.66 per cent of the respondents, who had low and high yield indices, respectively.

Yuvaraj (2023) noted that most farmers were classified as having low (36.00 per cent) adoption of various CSA practices, followed by medium (34.33 per cent) and high (29.67 per cent) adoption levels.

Yuvaraj (2023) noted that factors like education, farm size, yearly income, creativity, climate change awareness, and input utilisation patterns displayed a positive, significant correlation at the 0.01 level with mass media exposure. The ability to take risks, farming system, and training on CSA demonstrated a positive and significant correlation at the 0.05 level. In contrast, farming experience revealed no noteworthy correlation with farmers' knowledge level regarding CSA practices for paddy. In terms of age, there was a negative and significant correlation at the 0.01 level with the respondents' knowledge level regarding CSA practices for paddy.

Yuvaraj and Chintagunta (2023) noted that independent factors like risk orientation, education, cosmopolitanism, scientific orientation, participation in extension programmes, mass

media exposure, innovative tendencies, and extension contact positively and significantly correlated with adoption at the one per cent level. Economic motivation showed a positive and significant correlation with adoption at the five per cent level. The other variables, namely type of family, age, family size, farming experience, land holding, annual income, and social participation, showed no significant relationship with adoption.

Mishra *et al.* (2024) recognised significant limitations experienced by respondents in implementing climate-smart agricultural approaches, grouped into economic, socio-personal, and technological limitations. Farmers in non-climate-smart villages mainly encountered technical challenges, such as insufficient awareness, lack of training, and the complexity of practices. Conversely, farmers in climate-smart villages faced financial challenges such as rising production expenses and reduced outputs. Recommendations for improved adoption may involve upgraded training initiatives, awareness efforts, and monetary assistance to ease financial pressures and enhance comprehension of climate-smart methods.

Naik *et al*. (2024) revealed that the overall composite LVI value is 0.41, which shows that farmers in Cuttack district are moderately vulnerable to climate change. Further, it shows that social networks, which have the highest value of the nine key components of vulnerability (0.9), have a significant impact on vulnerability. The sub-components hence have the biggest influence on the social network index in the Cuttack area. The second-most significant elements affecting vulnerability as key components are livelihood strategies (0.656923). The remaining seven other factors are there in order of their vulnerability as Food (0.594872), Climate variation and Natural Disaster (0.569967), Knowledge and Skill (0.486154), Water (0.403846), Wealth and Assets (0.330769), Socio-Demographic Profile (0.115159), and Health (0.102564).

Shweta *et al*. (2024) elicited that the farmers recommended implementing training sessions on climate change, organizing capacity-building efforts, improving access to institutional credit, and expanding cattle insurance. They highlighted the importance of understanding adaptation strategies and receiving timely weather updates to lessen the effects of climate change.

Billah *et al*. (2025) proposed that programs focused on awareness and motivation for farmers ranked highest at 89.48 per cent. In contrast, 86.41 per cent of respondents recommended subsidies for CSA interventions, 82.31 per cent for the establishment of farmers' organizations, and 70 per cent for the reform of agricultural extension services as having significant potential. A small percentage (34.62 per cent) of respondents expressed their views on the use of precision agriculture to advance climate-smart farming systems.

Chintakindi *et al.* (2025) found that majority (69.72 per cent) of the respondents utilising and obtaining Weather-Based Agro-Advisory Services (WBAAS) were in the medium category, with low (27.23 per cent) and high (3.05 per cent) categories following.

Kanade *et al.* (2025) found that over half (53.34 per cent) of participants have attained a secondary level of education, with graduate and higher levels at 18.32 per cent, while 13.34 per cent fall into the 10th to 12th education category. 10.00 per cent of those surveyed were unable to read or write, and merely 05.00 per cent had obtained education at the primary level.

Mishra *et al*. (2025) demonstrated that knowledge and income had a strong relationship with the adoption of CSA technologies in flood-prone regions, whereas family size and education also had a significant relationship with adopting CSA technologies. Other factors, such as age, marital status, size of landholding, extension contact, scientific orientation, and family type, did not show statistically significant relationships with levels of adoption.

Tala *et al.* (2025) indicated that over half (71.00 per cent) of participants showed a moderate level of scientific orientation, with high orientation at 16.00 per cent and low orientation at 13.00 per cent.

Tala *et al*. (2025) reported that 59.00 per cent of cumin growers possessed a high level of knowledge regarding climate-smart agriculture, while 27.67 per cent had an intermediate level, and 13.33 per cent possessed a low level of knowledge about climate-smart agriculture.

Tala *et al.* (2025) indicated that personal, socio-economic, communication, and psychological variables such as scientific orientation, education, risk orientation, and innovativeness have shown a positive and highly significant relationship with knowledge of climate-smart agriculture, while farming experience, mass media exposure, and extension contact have shown a positive and significant relationship with knowledge of climate-smart agriculture. While age, land ownership, and yearly income showed no significant correlation with knowledge about climate-smart agriculture.

Patel *et al*. (2026) demonstrated that the Climatic Vulnerability Index (CVI) based on Farming System Typology (FST) assesses the variations in exposure, sensitivity, and adaptive capacity across the four FST groups, offering insights into their overall vulnerability under NICRA initiatives. FST-4, characterized by irrigated farming with livestock, exhibits lower vulnerability indices (0.52). The vulnerability scores for FST-2 and FST-3 are quite similar, at 0.70 and 0.75, respectively. The FST-1 (Rainfed without livestock) has the highest vulnerability rating with a CVI of 0.83.

(5) RESEARCH METHODOLOGY	
Location of Research	The study will be conducted in *Saurashtra* region of Gujarat state.
Sampling Technique	Purposive and multistage sampling procedure will be used for the selection of respondents.
Selection of the Respondents	Total 288 respondents will be selected by random sampling technique.
Research Design	A researcher's chosen methodologies and strategies for conducting a study are referred to as the research design. It provides a chance for the researcher to have sophisticated methods of doing study that are appropriate for the topic and so establishes the groundwork for the study's success. The research methodology employed in this study will be ex post facto. Ex post facto, sometimes referred to as "after-the-fact" research design, is a non-experimental research technique used to explore the causal relationship between independent and dependent variables when human control or manipulation of the independent variables is not feasible for practical or ethical reasons. (Kerlinger, 1973)
Method of data collection	With the use of a structured interview that includes measuring tools for both dependent and independent variables as well as the respondent's information, the data will be directly collected. The interview schedule will be pretested with farmers who were not part of the study population in order to remove double-barreled questions, clarify terminology and cover subject matter. After then, the schedule will be updated and modified to reflect changes and recommendations from the farmers. The respondents will be personally introduced to the final schedule before it is used. The researcher will interview the respondents and then record their responses in the schedule. To obtain an objective response, the study's objectives will be conveyed to the respondents.

Analysis of the data	In order to obtain answers to the research questions, data must be categorized, arranged, manipulated and summarized. On the other hand, data analysis refers to using the analysis results to draw conclusions about the research relations under study. The research objectives will be taken into consideration when classifying, tabulating and analyzing the data gathered from the respondents. Following analysis, the findings will be analyzed and pertinent conclusions will be made in accordance with the study's goals. The data will be analyzed and interpreted using the following statistical methodologies and techniques: • Frequency and percentage • Arithmetic mean • Standard deviation • Coefficient of correlation (r) • Class interval • Analysis of variance (ANOVA) Whatever data will be collected, appropriate statistical tools will be used for the analysis of the data.

(6) PRACTICAL UTILITY OF THE RESEARCH PROBLEM

The present study enlightens the climate-smart agricultural practices in the groundnut by providing useful contribution into the present farming systems and will try to yield practical solutions to counter the challenge that arises due to climate variability.

The results of the study will help to identify the level of knowledge, extent of adoption and level of vulnerability present in the cultivation of groundnut in the Saurashtra region. Thus,

this study will yield a fair estimate of the gap between the adoption of CSA practices readily available. This will help to generate practical solutions to increase knowledge and enhance adoption at the grassroots level. Also, the study will explore the socio-economic perspective on the adoption of CSA practices and will play an essential role in developing an appropriate capacity development programme and training programmes. This investigation will help Junagadh Agricultural University and various other State Agricultural agencies in the following ways:

1. The study will help the administrators, planners, policymakers and extension functionaries to develop need-based and location-specific approaches to increase the adoption of climate-smart agriculture practices in the specific region.
2. The study will help to enhance the adaptive capacity of the farmers will be increased to significant levels, production risk will be reduced and a sustainable approach to agricultural development will be achieved to a great extent.
3. The study will help them to adopt appropriate climate-smart agriculture practices for better productivity and profitability. Also, they will be able to manage climate-related risk more effectively. Adoption of climate-smart agriculture practices will lead to efficient utilization of natural resources, decreased uncertainties and increased sustainability, leading to an ecological and resilience agriculture system.
4. The study will serve as a benchmark for researchers, research scholars, academicians, policymakers and administrators to get a glimpse into the CSA practices in the Saurashtra region.
5. The results will add on to the existing knowledge and also open up the scope for further research aimed at developing climate-smart agriculture in a region having similar climatic conditions.

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Signature of Student,
(Parth Nandania)

Signature of Major Guide,
(M. K. Bariya)

Research Proposal Letter

This is to certify that above mentioned research proposal of Ph.D. student **PARTH NANDANIA (Reg. No. 1010125018)** has been approved and recommended by Research Approval Committee (Agricultural Extension Education) during the year 2025-26 for partial fulfillment of doctoral program in the discipline of Agricultural Extension Education.

(M. K. Bariya)
(Signature of Major Guide)

(B. N. Kalsariya)
(Signature of Head of Department)

Place: Junagadh
Date: / /2026